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Proceedings of Observatories.

The following reports of the proceedings of observatories during the past year have been received from the Directors of the several observatories, who are alone responsible for the same :—

Royal Observatory, Greenwich.

With the transit-circle 12467 observations of transits and 12445 of meridian zenith distances were made in 1895, giving an average, excluding Sundays, of about 40 per night. About 3000 observations were made in the two months of August and September. The total number of stars observed during the year is 2633.

The Moon was observed 137 times with the transit-circle; the mean error in R.A. of Hansen's Lunar Tables with Newcomb's Corrections deduced from these observations is $-0^s{\cdot}065$. The errors for the years 1883–95 are as follows :—

	s		s		s
1883	+0·032	1888	+0·079	1893	+0·036
1884	+0·021	1889	+0·010	1894	−0·019
1885	+0·028	1890	+0·020	1895	−0·065
1886	+0·029	1891	+0·079		
1887	+0·068	1892	+0·069		

The number of observations of pairs of reflexion and direct observations of stars in zenith distance was 642. The apparent correction to the Nadir observations deduced from these varies from $+0''{\cdot}03$ to $-0''{\cdot}50$ in the several months of the year. The mean for the year is $-0''{\cdot}26$, agreeing with the results of the three previous years. For the years 1890 to 1894 the corrections are $+0''{\cdot}08$, $+0''{\cdot}07$, $-0''{\cdot}25$, $-0''{\cdot}34$, $-0''{\cdot}27$.

The series of observations begun in 1894 December, in which pairs of stars of nearly the same N.P.D., and at an interval of 5 or 10 minutes in R.A., are observed in zenith distance, the one directly and the other by reflexion, alternately on alternate nights, was continued during the year. Altogether 320 observations have been made up to the end of 1895, giving 160 determinations of the R−D discordance.

The personal equation machine has been used to determine personality in observations of the first and second limbs of the Sun or Moon. Altogether 24 determinations of the personality of six observers have been made during the year.

The Moon has been observed with the altazimuth in the first and last quarters as in previous years, 66 observations being made in the year. The building of the new altazimuth pavilion was completed, and the dome erected in the autumn. The heavier portions of the new altazimuth were placed on the pier on May 6, and the instrument is now being mounted. A working catalogue of fundamental stars for the azimuths in which the instrument will be used has been prepared, as well as various tables required in the reductions.

Two comets were observed during the year with the Sheepshanks equatorial: Encke's comet on eight nights, and Comet (*d*) 1895 on one night; Comet (*c*) 1895 (Perrine) was observed with the altazimuth on two nights.

Forty-eight occultations of stars by the Moon were observed during the year, 21 of these, of which altogether 139 observations were made by 11 observers, occurring during the total lunar eclipse of 1895 March 10. Thirty-two phenomena of *Jupiter's* satellites were observed with the altazimuth or one of the equatorials.

With the 28-inch refractor 277 sets of micrometric observations of 153 double stars have been made, all the measures of a star on one night (usually 4 of distance and 3 of position-angle) being counted as one set. In 92 stars the distance between the components was under 1″·5, and in 30 of these under 0″·5. A good series of measures of κ *Pegasi*, a pair which is closing rapidly, has been obtained, the last measures being made on November 18, when the distance apart was less than 0″·1. Measures of the diameters of *Jupiter* and his satellites begun in 1894 were continued on 19 nights. Altogether 263 measures were made of *Jupiter's* equatorial diameter, 216 of the polar diameter, and about 50 measures of the equatorial and polar diameters of each of the satellites. In addition to these 100 measures of *Jupiter's* equatorial diameter were made with the double-image micrometer. About 800 measures of the diameters of *Saturn* and his rings and of the diameter of *Titan* were made on 14 nights with the filar micrometer. The measures of *Jupiter* and *Saturn* have been published in the *Monthly Notices*, and the measures of double stars will be communicated to the Society shortly.

With the half-prism spectroscope 284 measures have been made of the displacement of the F line in the spectra of 29 stars, and 15 measures of the *b* line in the spectra of 4 stars; 38 measures of the displacement of these lines in the spectrum of the Moon have also been made as a check on the adjustments. A few experiments have also been made in photographing stellar spectra.

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A considerable improvement in the conditions of observing with the 28-inch equatorial has been effected by the use of canvas sails to act as wind screens on the two sides of the shutter opening of the 36-feet dome. These sails, which were completed at the end of February, are each 22 feet high by 8 feet wide, and can be hauled up and down easily by peculiar tackle specially suited to the conditions of the case.

The photographic telescope of 26 inches diameter presented by Sir Henry Thompson is being constructed by Sir H. Grubb, and will, it is hoped, be ready very shortly for inspection at his works. The crown disc for the 26-inch object-glass was supplied last March, the flint having been delivered in the previous August.

With the Astrographic Equatorial (which was not in use till February 25, during the repair of the shutter, which was blown off the dome during the gale on 1894 December 22) 547 plates with 1,382 exposures were taken in the year 1895 on 120 nights; and of these 138 have been rejected—viz. 53, as not coming up to the standard in showing faint stars; 41, from the *réseau* not being printed sufficiently clearly; and 44 on account of partial fogging, wrong setting, faulty development, or mechanical injury. Of the 409 successful plates, 82 are for the Chart, 263 for the Catalogue, 45 are Standard Areas, 10 for the adjustments of the instrument, 5 are photographs of other regions, and 4 were taken with the enlarger (enlargement six times). When practicable a trail has been taken each night on a catalogue plate, and 72 plates with trails have been secured.

Each plate has undergone a preliminary examination to see whether it was generally satisfactory, and whether the limits of magnitude were approximately reached as inferred from the 20^s exposure, which should give 9th magnitude stars of Argelander's scale. When the measurement of the Catalogue plates was begun, it was found that many photographs which had been previously passed were not suitable for measurement with the glass-scale micrometer. A revision of the plates previously passed has been made, and such as were not considered suitable for measurement have been rejected.

The following table shows the progress made in the photographic mapping of the heavens up to the end of 1895:—

Zones Decl.	No. of Fields Required.	No. of Fields Photographed For Catalogue.	For Chart.
65°–69°	376	354	224
70–75	360	255	184
76–80	216	76	71
81–90	197	0	0
Total ...	1149	685	479

Measurement of the plates for the Catalogue is being systematically carried on with the duplex micrometer mentioned

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in the last Report. Both the 6^{m} and 3^{m} images are measured and the means taken. During the year 493 quarter plates have been measured, which, with 16 quarter plates measured at the end of 1894, gives 509 quarter plates, equivalent to 127 plates, as the total number measured. The rate of measurement has been increased to about 180 plates a year since October.

The stars in the following portions of the sky have already been measured on each of two plates:—

Decl.	R.A. h m		h m	
65°–66°	11 15	–	0 36	
66–67	11 24	–	0 0	
67–68	11 30	–	0 0	(Except $22^{h}\ 10^{m}$ – $22^{h}\ 30^{m}$)
68–69	19 0	–	20 0	

On the 496 quarter plates, which cover these portions of the sky, the images of 17,250 stars have been measured, and of these 13,250 have been measured on each of two plates. The number of stars per plate varies greatly in different parts of the sky. The largest number on any plate completely measured as yet is 664 on the plate whose centre is at R.A. $21^{h}\ 54^{m}$ Decl. +66°; and the smallest is 67, on the plate whose centre is at R.A. $2^{h}\ 42^{m}$ Decl. +66°.

Towards the determination of the Right Ascensions and Declinations of the stars the following steps have been taken. From the Right Ascensions and Declinations given in the catalogues of the *Astronomische Gesellschaft*, "Standard Co-ordinates" have been deduced for all stars on 72 plates which are contained in these catalogues. By a comparison of these with the measured co-ordinates, plate-constants have been determined, from which the "Standard Co-ordinates" of other stars on the plates may be obtained by means of a linear correction, and the Right Ascensions and Declinations deduced by a trigonometrical transformation, if desired. A full account of this, as well as of the comparison of 30 overlapping plates, is given in the *Monthly Notices*, 1896 January.

Some experiments have been made in the reproduction of the Chart plates, so as to form a map of the portion of the sky from R.A. $19^{h}\ 0^{m}$ to $20^{h}\ 50^{m}$, and Decl. 64° to 71°. Positives on glass of the 37 negatives covering this region have been taken, and from these platinotype, gelatino-chloride, and bromide card-prints have been made for comparison. From a preliminary examination of these, it seems that the bromide cards are the most suitable, and that on these very few, if any, stars are lost, which is far from being the case with the platinotype prints. The bromide cards have the advantage of not needing to be mounted and rolled, and are very convenient for use.

The Dallmeyer photoheliograph, of 4 inches aperture, now mounted on the terrace roof of the south wing of the new building in the south ground, has been the only instrument employed for solar photography in 1895, the Thompson photoheliograph not being at present available, in consequence of the progress of the building operations, in the course of which the Lassell equatorial and dome have been dismounted. With the Dallmeyer instrument photographs of the Sun were obtained on 234 days, and of these 482 have been selected for preservation, including 13 with a double image of the Sun, taken to determine the position of the wires with reference to the parallel of declination. Photographs have also been received from India up to 1895 November 5, and from Mauritius up to 1895 July 25, leaving only one day—1895 January 7—for which no photograph is yet available for measurement in the year ending with the date of the last Mauritius negative received.

The Greenwich photographs have been measured in duplicate up to the end of 1895, and the areas and heliographic positions of the spots and faculæ have been computed. The complete results for 1893 have been printed, and the daily results for 1894 have been passed for press up to April 26; the manuscript has been sent to the printer up to May 30, and that for the rest of the year is nearly ready. The measurements and reductions for 1894 proved distinctly heavier than for 1893, although there was a falling off in the mean daily spotted area. This was owing to the number of small groups, and to the great complexity of some of the larger groups. The decline in the spotted area has continued through 1895, and has brought about a slight diminution in the work of measurement and reduction; the number of volumes of the forms used in the computation of the areas and heliographic positions of the spots being fewer in 1895 by about one-fifth than in 1894, and by about one-tenth than in 1893. The work, therefore, is still very heavy, for on no occasion in 1895 was the Sun free from spots.

The publication of the final results of the Greenwich-Montreal longitude determination has been delayed, owing to the pressure of other work, and the inadequacy of the existing permanent staff.

The transit observations at contiguous stations in the front court, to determine the difference of longitude between them were continued on four nights with the instruments used in the Paris-Greenwich longitude determinations. The observations have not yet been reduced.

Observations were made on the pier of the Transit Pavilion by Captain Burrard, R.E., and Captain Conyngham, R.E., to determine the difference of longitude of Greenwich and Potsdam, in connection with the re-determination of the longitude of Madras. From June 14 to July 1 Captain Burrard was at Greenwich and Captain Conyngham at Potsdam; they interchanged stations July 11–25, and determined their personal equations at Greenwich May 28–30, and at Potsdam July 30–August 3.

The volume of *Greenwich Observations* for 1893 is printed, with the exception of the Introduction, of which proofs have

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been received. The printing of the volume for 1894 is advancing.

Electric lighting was introduced throughout the Observatory, with the exception of the Magnetic Observatory and the new Physical Observatory, last June, and has also been applied successfully to the principal instruments, including the Transit Circle. It is thoroughly satisfactory and economical.

The building of the north wing and completion of the central octagon of the new Physical Observatory, on which the Thompson 26-inch photo-telescope will be erected, was begun in 1894 September. Delays occurred from the severe frost of last spring, and later from failure in the supply of terra-cotta, and the building is not yet quite finished. Meanwhile the Lassell Dome was dismounted by Messrs. Cooke, so that its re-erection can be begun as soon as the building is ready. The Merz Refractor (12·8-inch), which was mounted on the Lassell Equatorial, will be used as a guiding telescope on the Thompson photographic telescope.

There have been no changes in the permanent staff during the year, and the two vacancies among the second-class assistants have not yet been filled up, a scheme for reorganisation of the staff being still under the consideration of the Government.

The Observatory will shortly lose the services of Mr. Criswick, who retires on pension on January 31, after a useful and honourable service of forty-one years at the Observatory.

Royal Observatory, Edinburgh.

During the year 1895 great progress has been made towards the completion of the new Royal Observatory at Blackford Hill. The dwelling-houses have been occupied for several months, and the boundary wall is now nearly finished. The Dunecht 15-inch refractor by Grubb was mounted in the east dome in July and August, and finally adjusted in September, since which time it has been regularly employed in observations of comets, and occasionally of minor planets, but the work has been much interrupted by unfavourable weather.

The sidereal clock by Frodsham formerly at Dunecht has been mounted in a specially prepared clock chamber, together with the standard sidereal clock by Dent, presented in 1855 to the Calton Hill Observatory by Sir Thomas Makdougall Brisbane. The Brisbane clock has been fitted in a cast-iron air-tight case, in which a constant barometric pressure of twenty-five inches is maintained. The clock chamber is in the base of the pier of the large east dome. It is lined with silicate cotton, and is provided with two double doors packed with the same non-conducting material, so that the temperature in the chamber remains nearly constant during long periods. These two clocks are connected with a small chronograph by Fuess, which is mounted

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in the chronograph room, under the west dome, and also with a sounder in the experimenting room, by means of which the comparisons with the mean-time clock by Molyneux are made. The Fuess chronograph is provided with two signal levers, so that observations made at any two different instruments can be recorded simultaneously. The large four-barrel chronograph by T. Cooke & Sons is in process of being mounted.

The time service, which includes the working of the time ball on the Nelson Monument, the firing of the time guns at Edinburgh Castle and at Dundee, and the controlling of clocks throughout the city of Edinburgh, was transferred from the old Observatory to Blackford Hill on November 8, and has since been carried on without interruption, the time observations being made with the fine 4-inch reversing transit by T. Cooke & Sons, and the time distributed by the Molyneux clock.

Observations for the determination of the difference of longitude between the old and new Observatories were made by Mr. Heath and Mr. Ramsay on seven nights in the autumn with the 6·4-inch transit instrument at Calton Hill and the reversing transit at Blackford Hill. As at that time there was no telegraphic communication between the two stations, two mean-time chronometers were each night carried to and fro between the Observatories, two journeys being usually made each way. In order to eliminate personal equation, the observers changed stations when about half the observations had been made. The result places Blackford Hill $1^s{\cdot}17$ west of Calton Hill, with a probable error of $\pm 0^s{\cdot}05$. The adopted longitude of the transit house at Blackford Hill is $12^m\ 44^s{\cdot}2$ west of Greenwich, and of the 15-inch refractor $12^m\ 44^s{\cdot}0$.

The workshop, with its lathes and other apparatus, and the large photographic rooms have been in use for some months. The barograph and barometer, the thermometers and rain gauges, were all mounted in good time to begin a continuous meteorological record on 1896 January 1. A monthly return will be made to the Scottish Meteorological Society.

Although work at the old Observatory was given up in November, the rain-gauge record there was continued to the end of the year, when it was taken up by the city authorities, by whom it is now being carried on. The old Observatory has been acquired by the city, the transit instrument, mural circle, and vertical circle having been left there on loan, with the sanction of her Majesty's Government. The weekly readings of the rock thermometers there will however be continued, as before, by one of the Royal Observatory staff. The regular daily readings of the bifilar pendulum at Calton Hill were carried on by Mr. Heath until October 28, when the instrument was removed to Blackford Hill, where it will be remounted along with a similar pendulum vibrating at right angles to it, the pair being arranged to give a continuous photographic record. On June 9 a curious instance of sudden oscillation of the pendulum was observed, and a short account of it was published in *Nature* of July 4. The total oscillation in the plane of the meridian was $0''\cdot4$ of arc to the north and $0''\cdot5$ to the south.

The reduction of the observations made by Mr. Heath for the re-determination of the latitude of Calton Hill has been completed. The arithmetic mean of 218 observations gives

$$\phi = +55^\circ\ 57'\ 23''\cdot19 \pm 0''\cdot04,$$

in exact agreement with Henderson's determination made with the same instrument sixty years ago. Dr. Chandler's reduction to mean latitude was computed from the equation given in the *Astronomical Journal*, vol. xiv. p. 74, but did not sensibly affect the above result or its probable error. It does not appear, therefore, that the observations with the Mural Circle are of sufficient accuracy to show the small periodic changes of the latitude.

The 24-inch Grubb reflector from Calton Hill is in process of erection in the west dome at Blackford Hill, and will shortly be ready for use. The driving clock is being provided by Messrs. Ritchie & Son, of Edinburgh, with maintaining power and electric control. The Transit House is now ready for the Dunecht 8·6-inch Transit Circle, which is still in the hands of Mr. Simms, who has retouched the object glass and made some improvements in the illumination, &c.

Mr. Ramsay has been engaged during nearly the whole of the year in the arrangement and fitting up of the new Observatory, and in mounting the instruments and clocks. He has now practically completed the extensive system of electric wires for the sympathetic clocks and chronographs, by means of which observations made with any of the instruments in the Observatory can be recorded on either of the chronographs. Mr. Ramsay has also, to a large extent, conducted the business correspondence of the Observatory.

In September Dr. J. Halm joined the staff of the Observatory, and has since been in charge of the 15-inch refractor, with which the following observations of comets have been secured: Comet Swift four times, Perrine once, and Brooks nine times. He has also given much time to arranging the books of the Crawford Library, which are now completely accessible, while considerable progress has been made with the books from Calton Hill. Dr. Halm has made some observations with the reversing transit in the prime vertical for the latitude of Blackford Hill, the result being in close agreement with the value $+55^\circ\ 55'\ 28''\cdot0$, found by Dr. Becker, which may be safely retained as the provisional latitude of the Observatory.

In spite of the varied work in hand the reduction of the Henderson observations has not been lost sight of, and has made steady progress in the hands of Mr. Heath.

During the year six circulars have been issued, referring to the comets above mentioned. To these circulars valuable contributions have again been made by Mr. A. Berberich, of Berlin.

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Royal Observatory, Cape of Good Hope.

Mr. J. Power has been appointed junior assistant *vice* Mr. W. H. Cox, promoted.

The chief feature of the work of the Observatory during 1895, following the policy indicated in last report, has been the progress made in overtaking arrears of reduction and publication.

The Cape General Catalogue for 1885, with its appendices, and the annual results of meridian observations for 1885, 1886, and 1887, have been printed, and during the year have been placed in the hands of astronomers. The annual results of meridian observations for 1888, 1889, 1890, and 1891 have been passed through the press. The manuscripts of the annual results for 1892, 1893, and 1894 are in the hands of the printer, and some of the sheets have been passed for press.

The printing in two volumes of *A Determination of the Solar Parallax and the Mass of the Moon from Observations of Iris, Victoria, and Sappho,* is approaching completion. The part of the work referring to the meridian observations of the comparison stars is by Professor Auwers, that of the discussion of the heliometer observations of *Iris* by Dr. Elkin.

The first volume of the Cape Photographic Durchmusterung, containing the places of 152,000 stars, derived by Professor J. C. Kapteyn from the Cape photographs, between the limits of Declination −19° and −37° (both inclusive), has been passed through the press. The introduction is in the press. The manuscript of vol. ii. of the same work, containing the places of 158,000 stars between the limits of Declination −38° and −52° (both inclusive), is ready for press.

A complete account of the Geodetic Survey of South Africa has been passed through the press, with the exception of the index and general map, which are still in the printer's hands, besides an account of the new Geodetic Survey executed by Colonel Morris, R.E., under the direction of H.M. Astronomer. The whole includes a complete re-reduction of Sir Thomas Maclear's triangulation and a comparison of the astronomical results with the geodetic latitudes, longitudes, and azimuths, computed both with Clarke's and Airy's elements of the Earth. The work has been printed at the Cape for presentation to the Cape Parliament at its next session, and will afterwards be distributed.

The current reductions of meridian observations are advanced as follows :—

The computations of Mean R.A. are complete to 1895 Sept. 3
" " " N.P.D. " " Nov. 22
" " Apparent R.A. " " Sept. 3
" " " N.P.D. " " Dec. 31
" " R.A. corrected for collimation and level only are complete to ... Dec. 1

Note.—The reductions in R.A. after September 3 were necessarily delayed until the double transits of circumpolar stars observed during the winter months had been discussed, and definitive places formed for determining the azimuth in those seasons when double transits could not be obtained.

The Cape Ten-year Catalogue for the Equinox 1890 is well advanced, and will contain the results of all meridian observations of stars made since 1885 August 24 till the end of 1895, reduced to the Equinox 1890, excepting the circumpolar stars, fundamentally observed in 1895, which will be given in an appendix reduced to the Equinox 1895. All observations to the end of 1894 have been reduced to the common Equinox 1890, and the means have been taken. The corrections for flexure, change of latitude, &c., have still to be made, the mean latitude, refraction, &c., to be discussed, and the corresponding corrections applied.

With the special provision made for the reduction of Sir Thomas Maclear's observations, 1861–70—

The Apparent Right Ascensions have been examined to 1864 December 31;

The Apparent N.P.D.'s have been examined to 1867 August 13.

The star-corrections for 1861–1866 and for 1868 are computed. The tabular places of the Moon corresponding to the instants of transit have been computed for the years 1862, 1863, and 1864.

The observations made with the zenith telescope for aberration and change of latitude are completely reduced to mean difference of zenith distance (north—south), and corrected for screw-error, &c. The results are being finally revised previous to discussion.

With the heavy pressure of other arrear work the heliometer observations for stellar parallax, the heliometer and photographic observations of *Jupiter's* satellites remain unreduced. The occultations observed since 1881 have been partly reduced, and the work will be completed as soon as circumstances permit.

The progress made in overtaking arrears of publication and reduction has been purchased at the severe price of limiting the observing activity of the staff, a policy which H.M. Astronomer has followed with great reluctance, but which was the only alternative one to that of increasing, instead of diminishing, the already large stock of unreduced and undiscussed observations. Mr. Power's appointment to fill a position in the staff which had practically been vacant since 1892 April, has, to a certain extent, relieved the pressure. But in view of past experience and the necessity of making provision for efficient working of the McClean telescope, it is obvious that a substantial increase in the Observatory staff is essential.

During the year 1894 nearly the whole of the observations for the Cape Ten-year Catalogue for 1890 were completed. It remained to make a series of fundamental observations of circumpolar stars to form an appendix to the Catalogue similar to that attached to the Cape General Catalogue for 1885; the instrument accordingly has been almost exclusively devoted to this work.

These observations naturally occupy much longer time than observations of quicker moving stars, hence a comparatively small number of observations was obtained.

With the transit-circle there have been made :

Number of transits observed	2872
Number of declinations	2240
Determinations of collimation	94
,, level	276
,, azimuth	437
,, run	247
,, nadir	248
,, flexure	48

The following occultations of stars by the Moon were observed :—

Disappearance at the dark limb	8
Reappearances	5
No. of separate phenomena	13

With the zenith telescope : Investigations of the errors of the screw and values of levels and screw have been made in connection with the series of observations for aberration and change of latitude.

There were no comets favourably situated for observation from this Observatory.

Comet *Brooks* was searched for but not found, as no motion was given in the cable message, and attention was chiefly given to sweeping *south* of the position given; but the comet was moving rapidly to the north. The 6-inch equatorial, which alone has an eyepiece of large field, was dismantled at the time, its dome being under repair.

Comet *Perrine* was seen once only, viz. on the morning of December 13, near the eastern horizon, the star *Antares* being visible in the same field. The image of the comet faded in the advancing daylight before the definition was sufficiently steady to permit observations to be made. The image of the star remained bright and observable after that of the comet had become invisible. All attempts to detect the comet near perihelion in daylight were unsuccessful. After perihelion the comet could be seen from Sea Point after sunset, but was hid from the

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Observatory by Table Mountain, which cuts off about 8° from the horizon in that azimuth.

With the photographic telescope the following work has been accomplished :—

	No. of Plates	Exposures	
	Exposed.	No.	Duration.
Catalogue plates	91	273	6^m, 3^m, 20^s each
Chart plates	367	367	(up to) 60^m
Kapteyn-Pritchard areas ...	61	183	6^m, 3^m, 20^s
Circumpolar plates for Professor Jacoby	16	48	6^m, 3^m, 20^s
Speed, trial and adjustments	14	28	
Plates for light curve of R Velorum...	18	129	6^m
Stars suspected of variability in Kapteyn's discussion of the Cape Photographic Durchmusterung	57*	144	6^m

Of the 367 chart plates exposed, only 240 have been passed as successful. The failures have arisen in part from interruptions by cloud and by bad definition, but chiefly because two successive supplies of plates turned out to be faulty ; so that, though the rejected negatives would be available for purposes of measurement, they are unfit for photographic reproduction for chart purposes.

Of the ninety-one catalogue plates exposed only fifty-five were completely successful.

The state of the work stands as follows :—Of the 1512 catalogue plates assigned to the Cape, 1497 have been successfully taken, so that only fifteen remain to be done.

Of the 756 chart plates (even degrees), 503 have been successfully taken, leaving 253 to be done. There remain also 756 chart plates (odd degrees) to be taken, about which the Permanent Committee has not yet decided whether single, double, or triple images of the stars are to be adopted.

Thirty-four catalogue plates, containing 2557 stars, have been completely measured (diameters included) by two independent observers.

The diameters of the discs of the variable star *R Velorum*, together with those of 9 comparison stars, have been measured for all the plates taken to the end of 1895.

A complete investigation of the Réseau Gautier No. 8 has been made, in which the error of sinuosity of every line at twenty-six points on each line has been determined, and all the errors rigorously discussed and tabulated. The results, in the form of a paper by Dr. Gill and Professor Harold Jacoby, will be communicated to the Society.

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* These plates are taken on nights of bright moonlight, &c., when conditions are unfavourable for taking chart plates.

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Complete Tables of Reduction for the zones −41° and −42° have been computed.

Much time and thought have been given to points connected with the details of the design of the McClean telescope with its accessories and Observatory. H.M. Astronomer has been in almost weekly correspondence with Dr. McClean, a correspondence which has involved the preparation of many sketches and original designs. Dr. McClean has himself laboured indefatigably on the same work, with the result that the designs for all details of the telescope, spectroscope, and Observatory, with its rising floor and dome, are now completed. The building of the Observatory has been begun, and will be ready for the erection of the dome by 1 March. Dr. McClean has provided a developing-room, a study, and store-room, attached to the new Observatory.

The time-signal service has been regularly maintained.

The meteorological observations made at the Observatory in 1895 have been communicated for publication to the Cape Meteorological Commission.

Cambridge Observatory.

The Catalogue of Zone Stars, undertaken by the request of the Astronomische Gesellschaft, taxed nearly all our resources during the past year. It was judged necessary carefully to examine the co-ordinates of each star with their annual precessions and secular variations; and, though this was facilitated by tables constructed not many years after the observations commenced, it has involved much time and care. In accordance with the original arrangement, the printing is done in Germany, to secure uniformity in the volumes of this extensive catalogue of stars in the northern hemisphere, and the proofs of the portion assigned to us are always sent hither for correction and revision.

The press-work has been carried on as far as $17^h\ 35^m$ right ascension, and contains 8,350 places of stars.

Besides this, a comparison of these places with the earlier catalogues—chiefly Bessel, Lalande, and Argelander—has been undertaken. More than 4,000 have thus been identified and compared; giving, in a good many cases, interesting results. In not a few instances there are decided evidences of large proper motion, proved by comparing with ours the places given both in Lalande and Bessel. These and other suspected cases are registered for future observation.

The observations of zone stars during the year number 213; made, for the most part, to settle questions or solve doubts that have arisen in the examination of the Catalogue. There are eight observations of stars which had been compared with Gale's Comet, and of course the requisite number of observations for clock and instrumental corrections.

Another volume of the *Cambridge Observations* is passing through the University Press; and it is hoped that we shall soon be in a position to place in the hands of the printers the larger catalogue, which contains the result of each individual observation of every star in our zone.

The Newall Telescope, Cambridge Observatory.

The Newall telescope has been used for observations on 145 nights in the course of the year 1895.

In the early part of the year the work done was chiefly micrometer work, partly in determining accurately the arc value of a revolution of the micrometer screw for use in the reduction of the observations of the inner satellite of *Mars*, partly in the observation of detail on *Jupiter*; with special reference to the motion (i) of small spots on the surface, and (ii) of the surface near the red spot. The observations of the inner satellite of *Mars* have been published in the *Monthly Notices*, vol. lv. p. 348.

Observations of occultations of stars during the total eclipse of the Moon 1895 March 10 were made under exceptionally favourable conditions of atmosphere. The observations have been published in the *Monthly Notices*, vol. lv. p. 334.

At the end of April the new spectroscope, the design of which, as was stated in last year's Report, had been put in the hands of the Cambridge Scientific Instrument Company in the previous summer, was received at the Observatory, and the adjustment was at once begun. The rest of the year has been devoted almost entirely to work with the spectroscope. This work has necessarily been of a preliminary nature, but the photographs obtained in the later months of the year have been increasingly valuable, as the instrument has been got into better adjustment, and the observers have acquired more experience in using it. Among the objects whose spectra have been especially studied may be mentioned the following:—

α *Boötis*, α *Cygni*, α *Lyræ*, chiefly for adjustment.

α *Aurigæ*, for the determination of velocity in the line of sight with iron comparison spectrum, to compare with the numerous determinations made at Potsdam.

γ *Cassiopeiæ*, with special reference to the bright Hγ line, the doubleness of which (first announced by Lockyer, *Proc. R.S.* vol. lvii. p. 173) has been fully corroborated.

α *Orionis*, with special reference to the bands in the yellow and green.

Orion stars, with Helium comparison spectra.

Venus, with reference to the possible determination of the period of rotation.

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Dunsink Observatory.

Owing to the necessity of bringing our catalogue of stars to completion, and to the heavy work of computing the precessions, secular variations, and proper motions, systematic observations with the meridian circle and chronograph have been discontinued during the greater part of the year, and these instruments have been chiefly used for the determination of the clock correction for the time service to Dublin. In November and December, however, Mr. Martin obtained 160 observations in right ascension and declination of the stars with large proper motion referred to in former reports.

The work on this catalogue commenced in 1885, but has been greatly interrupted since the beginning of the year 1888 by other observations with the meridian circle, by the changes which have taken place in the staff, and by photographic work with the "Roberts" equatorial.

The observations of stars with large proper motions are now fully reduced to the epoch 1890, and are almost ready for the press.

In reducing these observations the clock corrections and the equator point of the circle are both deduced from observations of the *Berliner Jahrbuch* standard stars. In general, however, observations of the nadir point are also made by reflexion from a trough of mercury.

The error of collimation of the meridian circle has been determined 28 times during the year, the level error 65 times, the nadir point (by reflexion) 23 times, and the error of runs 4 times. For determining the error of azimuth 20 transits of polar stars have been taken. For the purpose of determining the error of the Dent sidereal clock 295 observations have been made of the R.A. of the *Berliner Jahrbuch* standard stars, and 52 observations in zenith distance of these stars have been taken to determine the equator point of the circle.

In May the "Roberts" equatorial, which had been in Sir Howard Grubb's workshop, undergoing alteration, for almost a year, was re-erected. This instrument had in the interval been supplied with a new equatorial mounting and clockwork similar to those used at Greenwich, the Cape of Good Hope, and other observatories, for work in connection with the photographic survey of the heavens. The clockwork is of Sir Howard Grubb's latest pattern, with electric pendulum control, acting on a sector of 28 inches radius. Above the cross-head of the declination axis the instrument is in the same condition as when it was presented to the Observatory, except for some minor alterations, such as screw adjustments to the eye-piece slides, the illumination of the spider lines, &c. The new clockwork and mounting have, however, practically made a new instrument of it, and rendered it capable of taking photographs suitable for measurement.

The work of adjusting this instrument, and experiments of various kinds with it, occupied a large number of nights in May, June, and July, and it was not till towards the end of the latter month that systematic photographic work became possible. Since the end of August this instrument has not been in use, owing to the illness of the Director, but during the months of May, June, July, and August 32 plates were taken, representing a total of 80 exposures of various lengths, from a few seconds to 42 minutes. These include—amongst other objects—4 photographs of the Ring Nebula in *Lyra* and six of η *Cassiopeiæ* for a re-determination of its parallax. A good deal of trouble has been experienced in rating the control pendulum, but in every other respect the instrument now performs in a very satisfactory way.

Only a few plates have been measured at this Observatory during the year. In addition to a few plates, measures of which were necessary for getting the photographic telescope into adjustment—according to the method proposed by the Director, and published in the *Monthly Notices* for December 1893—2 plates containing photographs of Encke's Comet, taken by Mr. W. E. Wilson, at Streete, on 1894 November 30, were measured. The position of the comet as deduced from these plates was published in the *Proceedings of the Royal Irish Academy*, 3rd Series, vol. iii. No. 4.

During the early months of the year the "South" equatorial was used for measuring some double stars in connection with a research as to the effect of the colour of a star on the refraction which it undergoes.

Of these, 21 complete observations, consisting of 8 readings of each of the two screws for distance, and 4 or 6 of position-angle, were obtained.

The partial eclipse of the Sun which took place on March 25 was also observed with this instrument.

In October Mr. Charles Martin, late Senior Computer at Greenwich Observatory, succeeded Mr. Arthur E. Lyster, M.A., as assistant to the Director.

The time service to Dublin has been maintained as in former years; and on the first Saturday of each month the Observatory has been open to visitors, and the 12-inch "South" refractor placed at their disposal.

Durham Observatory.

The transit-circle has been used upon eighty-seven nights for determining the positions of a few stars near the pole that have not been observed for many years.

This Observatory being a second-class meteorological station, the usual observations have been taken every twelve hours and regularly forwarded to the Meteorological Office.

The equatorial has been used chiefly to explain its functions to students and to show the various heavenly bodies.

Glasgow Observatory.

The 6-inch transit-circle by Ertel was remounted during the spring of the year. Of the old instrument, the axis with telescope and circles and the microscopes have been retained, but the bearings of the pivots, the supports of the microscopes, the balancing arrangement, and the end-thrust are entirely new, and have been made by Messrs. Troughton & Simms. The parts that were replaced have been mounted on a table so as to exhibit the former features of the instrument.

In the new mounting the microscopes are in rigid connection with the standard on which the axis of the telescope turns, and the Vs are formed by pieces of gun-metal dovetailed into the cast-iron standards. The Vs admit of no adjustment, as each of the standards is cast in one piece. They were brought into position by levelling three projecting points on the stone piers to which the standards were finally bolted and cemented. Three months after the fixing the error of azimuth and the inclination of the axis were respectively $0^s{\cdot}02$ and $0^s{\cdot}20$.

The fulcrum of the balancing contrivance is on a level with the top of the stone piers. Small electric lamps of 1 candle-power, one for each of the ten microscopes, illuminate the circles, the light being conducted to the circles by means of glass rods polished at their ends. I may add that the accumulators which supply the current are charged by thermopiles.

Although the instrument was ready for use in July, observing was not begun then, as it was found desirable to replace the micrometer at the eye-end of the telescope. The micrometer had not arrived at the end of the year.

To the 20-inch "Breadalbane" Reflector a new driving clock with Russell control and a new sector have been fitted by Sir Howard Grubb. The various parts of the large spectroscope arrived at the end of October, but it has not yet been mounted on the reflector, owing to some faultiness in one of its parts.

During the year experiments on the controlling and the working of electric dials have been made at the Observatory, at the instigation of the Corporation of this city. It is intended to control from the Observatory eight clocks placed at various centres of the city, and these will in their turn work about three hundred street dials in twenty independent circuits.

The staff of the Observatory has been engaged in reducing and tabulating the old meteorological records, which date from 1843.

The time service and the extensive meteorological work have been carried on as in former years.

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Liverpool Observatory.

As in former years, the work of the Observatory has consisted to a very large extent in the determination and distribution of time, and in giving assistance to shipowners and chronometer-makers. The regulations put into force by the Mersey Docks and Harbour Board, to which reference was made in the last Report, have to some extent interfered with this work, as shown by the diminished number of chronometers deposited for test. The number is, however, slightly in excess of last year, and it is hoped in course of time the old figures will again be reached.

The meteorological observations have been continued on precisely the same lines as heretofore, and application is frequently made in salvage and collision cases for scientific information connected with the direction and velocity of the wind. The local importance of such matters has led to the examination of the changes in the barometer readings and direction of wind during severe gales, and it is proposed to publish the result with the Annual Report.

Comet observations have been prosecuted whenever possible. Faye's Comet was repeatedly looked for, but never seen with certainty. Those of Encke, Perrine, and Brooks have all been observed, and the results will be communicated to the Society.

The transit instrument has been occasionally mounted in the prime vertical for the determination of the declination of unknown stars with which the comets have been compared. A series of observations has also been commenced on the diameters of the larger planets, but has been much interfered with by bad weather. These observations began with the view of re-determining the value of the screws of the various micrometers, and especially of their errors, but have been extended to consider the effects of variously coloured illumination of the field on the measures themselves.

Courses of lectures have been given regularly in connection with the classes at University College, Liverpool, and opportunities have been given to the students for practical work with the transit instrument and the equatorial.

Radcliffe Observatory, Oxford.

The work at the Observatory during the year 1895 has included the following:—

The Moon was observed with the transit-circle at every available opportunity; and stars whose places were required either for comet comparisons or as a check upon the results of the Radcliffe Catalogue, 1890, were also observed.

The Barclay Equatorial was used during the year to a greater extent than usual.

Observations were made of Comet Encke on January 8, 18, 21, 23, and 25; that of January 25 being, as far as information is to hand, the latest observation anywhere taken of this comet during its recent apparition. Observations of Comet Swift (1895 August 20) were made on August 24, 28, September 18, 20, 25, 27, October 17 and 24. The results of these observations have been printed in the *Monthly Notices* (vol. lv. No. 3, vol. lvi. No. 2). These results do not adequately represent the time and labour expended on comet work, for careful searches were made for the above comets on many other nights, and also for Comets Faye, Perrine, and Brooks, but the mistiness of the sky or the faintness of the objects prevented their being picked up with the power of the Barclay telescope.

The magnitude of *Nova Aurigæ* was examined at intervals, but no change was detected during the year.

Venus was examined on four nights with variously tinted screens for reported markings on the disc, but nothing unusual was noted, except that on November 18, at $18\frac{1}{2}^{h}$, a hazy shadow was seen inside the limb, and having apparently nearly the same curvature as the planet's limb. It was considered by the observer as possibly due to contrast between the illumination of the body of the planet and the stronger light of the limb.

The great Nebula of *Andromeda* was also carefully examined. No change was remarked in the large nebula, but the nucleus of the smaller companion nebula was noted as "particularly stellar, as if it were a star surrounded by hazy luminosity," and in contrast to the irresolvable condensation of the larger mass.

Measures of eight double stars have also been made with the Barclay Equatorial during the year.

In conjunction with the heliometer, observations of the occultation of a selected list of stars were made during the total lunar eclipse of March 10. (See *Monthly Notices*, vol. lv. No. 6.)

Considerable attention has been devoted during the year to the early Radcliffe observations made by Dr. Hornsby. The observations of γ *Draconis* with the zenith sector have been reduced and published; and those made with the quadrants and transit instrument during the year 1774 are in process of reduction, and the results promise to be of very considerable value.

The large crayon drawing of the Moon, bearing the date 1795, made by John Russell, R.A., which has been in the possession of the Radcliffe Trustees for many years, having recently shown some traces of mildew, has been cleaned and reframed; and photographs have been taken and sent to the Society. (See *Monthly Notices*, vol. lvi. No. 3.)

A volume of the Radcliffe Astronomical and Meteorological Results for the years 1888 and 1889 has nearly passed through the press.

The meteorological observations and registrations have been carried on as usual.

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The University Observatory, Oxford.

During the year 1895 the energies of the Observatory have been directed chiefly to the work for the Astrographic Chart. The number of catalogue plates obtained was 337, bringing up the total number of regions photographed to 695.

Eighty-seven plates have been measured during the year. It is hoped that this number may be largely increased in future years, when an additional micrometer has been received from Mr. Simms. The total number of stars measured on these plates is 27,653. A description of the micrometer and methods of reduction are given in the *Monthly Notices*, vols. liv. and lv.

By the kindness of Sir Robert Ball, advance proofs of the *Cambridge Zone Catalogue* (R.A. 0^{h}—5^{h}) have been received, and the places brought up from 1875·0 to 1900·0 (2,350 stars) for use in the reduction of the catalogue plates.

Some experiments have been made to test the suitability of paper prints for accurate measurement, with encouraging results (*Monthly Notices*, vol. lvi. p. 28).

Some attention has been paid to the photography of minor planets with a view to the determinations of place or parallax. Nineteen plates, with from two to fifteen exposures on each plate, were taken of the planets *Pallas* ③ and *Eunomia* ⑮.

One of the *Pallas* plates, with exposures ranging over 5¼ hours, has been completely measured, and though the range of parallax factor is not large enough to give a result of any great value in itself, the accuracy of the method is clearly indicated; and it has been demonstrated that the method of reduction by rectilinear co-ordinates makes it possible to obtain a planetary parallax from a photographic plate with very little numerical labour. The plates of *Eunomia* have been only recently obtained, and the measures are not yet complete; but the conditions were much more favourable than for *Pallas*.

At the request of Dr. F. McClean three plates were exposed on the same region with different diaphragms in front of the O.G. of the Astrographic Telescope, the exposures, in numbers 14, 16, and 15 respectively, being arranged to compensate the diminution of aperture; and the plates were sent to Dr. McClean. A general examination of the plates assisted him in deciding some questions relative to the new telescope which he is presenting to the Cape Observatory; but a more complete discussion would be of interest and will be undertaken.

At the request of Mr. Newall, the distance between two stars in the Pleiades, suitable for the evaluation of a micrometer screw, was accurately determined (*Monthly Notices*, vol. lv. p. 419).

The Barclay Transit Circle was returned by Messrs. Troughton & Simms 1895 January, and mounted before the end of that

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month. Since then observations have been made of collimation, 166; of level, 176; of polar stars, 80; and of clock stars, 254. Besides these observations, the wire intervals and the values of R.A. and Z.D. screws have been determined. A considerable number of these observations were made by Mr. A. J. Walker, M.A. (New College), who took charge of the instrument during the October Term.

Lectures on elementary mathematical astronomy were delivered in the Hilary and Michaelmas Terms. Owing to the unsatisfactory position of astronomy in the University curriculum, there has been hitherto (during recent years) no demand for more advanced lectures; but a change has been effected during the past year which will, it is hoped, have beneficial results in attracting students to a more thorough acquaintance with the science.

A collection of photographs was lent to the Imperial Institute on the occasion of the Photographic Exhibition.

The arrangements for the eclipse expeditions of 1896 have occupied some time, and will probably claim a good deal of attention in the coming year.

Temple Observatory, Rugby.

The usual scholastic work has been continued during the past year, and this shows a tendency to increase. In original work, the measurement of position and distance of double stars has been continued, but the time left available for this has not been so much as in past years. It is hoped that the spread of astronomical interest amongst the boys will compensate for absence of other work.

Stonyhurst College Observatory.

The routine work of the meteorological and magnetical department has been carried on as usual, and the continuous recorders have been working well.

The new "Stonyhurst Sunshine Recorder," made by Messrs. Newton & Co., has been tested by comparisons with the "Campbell-Stokes" Recorder of the Meteorological Office, and has been found to work very satisfactorily. Some improvements have been suggested in the mechanical construction of the instrument, and have been accepted by the makers.

The instruments for absolute measures of the magnetic elements have been compared with the instruments adopted as standards by the Physical Section of the last meeting of the British Association for the Advancement of Science, with the object of co-ordinating the measures obtained at the several magnetic observatories of the United Kingdom. The results of these comparisons are expected at the next meeting of the same Association.

A partial reduction of the magnetograms to figures has been commenced: to the extent of four readings for each day—viz. maximum and minimum horizontal force and westerly direction, and the measures at 4 A.M. and 4 P.M. This work is well advanced for the past year, and will be extended to previous years, according as time allows.

Drawings of the solar spots and faculæ have been made on nearly all the days on which it was possible without too great an expenditure of time in waiting for clear intervals. And in connection with these drawings, photographs of the H–K. region of the solar spectrum have been taken with the grating spectrograph, in order to observe how closely the double reversals by integrated solar light follow the disturbances of the solar surface.

The spectroscopic experimental work with the Perry Memorial Objective was not completely finished until the end of April. These experiments represent a large number of photographic stellar spectra. But the plates are of no value for measurements, having been taken with thirteen different collimators and seven different camera lenses. Several prisms have also been tried, but not all photographically. The finally adopted arrangement is a slitless spectrograph, of one (or two) direct prisms of three components, with a concave compound collimating lens to bring all the rays between D and *h* parallel through the prism. All the parts of the spectrograph are the work of Mr. Hilger.

A very satisfactory wave curve has been plotted for the one-prism spectrum, and another will shortly be made for the pair of prisms.

A new series of photographs of the spectrum of β *Lyræ* has been obtained, consisting of seventy-seven plates. And of these, thirty-nine, or three good plates for each day of the light period, have been selected for measurement. The measurements were not complete before they were necessarily suspended in favour of the regular work of the Observatory, which is always more pressing in the first months of a new year.

A double series of photographic spectra of the brighter stars has been commenced—viz. with the single prism and with the pair of prisms. A wave-length map of the spectral lines of forty-three of the bright stars, photographed with the old 8-inch objective, was finished early in the year; but it was not thought well to offer it for publication until a more complete series was finished with the larger light collector.

Dr. Common's Observatory, Ealing.

The work of converting the 5-foot Newtonian Reflector into an Oblique Cassegrain has been in progress during the last year. In order to find the best results further experiments have been carried on, involving the construction of various convex surfaces.

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In the workshop two 16-inch plane mirrors have been made for the Cœlostats, for use at the next total solar eclipse, and one 16-inch has been made for the new telescope of the Cambridge Observatory, as well as others of less size.

Beyond some experimental photographs no astronomical work has been done of any importance.

Mr. Crossley's Observatory, Bermerside, Halifax.

The usual astronomical and meteorological observations were made during the year just closed. The *Jupiter* observations up to May have already appeared in the *Monthly Notices*. A 4½-inch photo-visual object-glass by Messrs. T. Cooke & Sons, of York, has been mounted here and carefully tested, visually, with excellent results, proving itself at least equal to a 5-inch object-glass of the usual kind.

Wolsingham Observatory. (Rev. T. E. Espin's.)

The new Observatory was not completed till April, and work was re-started on April 14. The total number of observations of variable stars, and with the spectroscope, is 1,113. The observations of stars with remarkable spectra have been forwarded to the *Astronomische Nachrichten*. This list contains: (1) Nos. 1,058 to 1,179; of these 18 are probably of Type IV.; the observation of 51 stars from Krüger's "Catalog der Farbigen Stenre," and various other objects to a total of 210; (2) 132 stars observed as III. ! (3) 458 stars observed as III. or II.—a total of 800 objects.

Observations tending to confirm the variation of the following stars have been made:—

Name.	R.A. 1900		Decl.		Var.	Type.
	h	m	°	′		
EsB 184	6	17·8	+25	4	8·9–9·7	IV.
EsB 189	6	20·3	+19	8	8·8–9·5	IV.
EsB 281	8	49·7	+17	36	6·4–7·9	IV.
EsB 357	12	35·8	+56	23	8·0–8·8	III.
Es 1021	19	42·9	+15	48	8·8–10?	III.?
Es 1169	19	52·4	−2	11	8·4–?	III.
EsB 679	20	33·4	+17	55	6·0–6·7	III.

Mr. Peek's Observatory, Rousdon, Lyme Regis.

The establishment continues in good working order, and observations have been made on 155 nights, this being rather less than the average number. During January and February on

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several clear nights the cold was so intense that the equatorial clock ceased to work, and the dome could not be rotated or the shutter raised. During the latter half of December the sky was almost continuously overcast.

The 6·4-inch Merz Achromatic Telescope has been kept regularly at work on long-period variable stars, and 518 determinations of magnitude have been secured, which is fully the average number.

The Red Star discovered by the Rev. T. E. Espin, 1894 November 30, has been added to the working list, and found to be a long-period variable. The observations show it to have ranged from 8·5 magnitude on January 8 to 10·3 magnitude on August 15, rising again to 7·9 by 1895 December 31.

Transit observations have been taken as often as required.

The lunar eclipse of March 10 was observed under very favourable conditions, special attention being directed to the occultations of the list of selected stars given in the *Companion to the Observatory.* Seven disappearances were secured.

Dr. Isaac Roberts's Observatory, Crowborough Hill, Sussex.

The work of photographing nebulæ and clusters of stars has, as in former years, been pursued, and the following list of the photographs, with exposures of 30 minutes and upwards, is given in continuation of the former lists, the last of which was published in the *Monthly Notices*, vol. lv. pp. 223, 224. The negatives are all available for reference :—

	R.A.	Decl.	Expos.
	h m	° ′	m
Tycho's *Nova* in Cassiopeia	0 16	+63 15	90
Great Nebula in Andromeda	0 36	+40 30	90
Neb. in Cetus	0 38	− 8 48	90
Neb. in Cassiopeia	0 47	+56 2	57 and 75^{m}
Region of γ Cassiopeiæ	0 50	+60 7	90 and 2^{h} 12^{m}
Neb. M. 33 Trianguli	1 28	+30 7	2^{h} 15^{m}
Neb. ♅ I. 152 Piscium	2 2	+10 30	54
Clusters in Perseus	2 11	+56 38	90
Neb. ♅ I. 102 Eridani	2 33	− 7 8	90
Neb. ♅ I. 63 Eridani	2 36	− 8 41	90
Cl. ♅ VIII. 61 Aurigæ	5 1	+36 55	30
Nova Aurigæ	5 24	+30 23	3^{h}
Neb. M. 1 Tauri	5 28	+21 57	60
Cl. ♅ VIII. 26 Geminorum	5 54	+23 18	30 and 60^{m}
Cl. ♅ VIII. 9 Geminorum	6 23	+16 46	3

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	R.A.		Decl.		Expos.
	h	m	°	′	m
Neb. in Monoceros	6	25	+ 5	0	54
Cl. ♅ VIII. 3 Monocerotis	6	29	+ 8	26	30
Cl. ♅ VIII. 50 Monocerotis	6	29	+ 5	26	30
Cl. ♅ VIII. 48 Monocerotis	6	32	− 1	22	30
Neb. near 15 Monocerotis	6	35	+ 10	0	90 : 2h and 3h
Cl. ♅ VIII. 31 Monocerotis	6	42	− 3	3	30
Cl. ♅ VIII. 71 Aurigæ	6	42	+ 41	11	30
Cl. ♅ VI. 2 Geminorum	6	49	+ 18	9	30
Cl. ♅ VIII. 40 Geminorum	7	1	+ 27	22	30
Cl. ♅ VIII. 33 Monocerotis	7	3	− 10	29	30
Cl. ♅ VIII. 36 Canis Majoris	7	23	− 11	32	30
Cl. ♅ VIII. 11 Geminorum	7	23	+ 13	59	30
Cl. M. 47 Argûs	7	50	− 15	8	30
Neb. ♅ I. 249–50 Ursæ Majoris	9	1	+ 60	42	90 and 3h
Neb. ♅ I. 2 Hydræ	9	5	+ 7	28	90
Neb. ♅ I. 167 Lyncis	9	7	+ 40	33	90
Neb. ♅ I. 216 Ursæ Majoris	9	9	+ 69	39	77
Neb. ♅ I. 113, 137 Lyncis	9	15	+ 34	35	90
Neb. ♅ I. 260 Ursæ Majoris	9	21	+ 62	57	90
Neb. ♅ I. 114 Leonis Minoris	9	36	+ 32	20	90
Neb. ♅ I. 61 Hydræ	9	37	− 3	10	90
Neb. ♅ I. 285 Ursæ Majoris	9	38	+ 68	24	90
Neb. ♅ I. 78 Ursæ Majoris	9	41	+ 72	46	90
Neb. ♅ I. 115 and V. 26 Leonis Minoris	9	43	+ 33	58	72
Neb. ♅ I. 286 Ursæ Majoris	9	55	+ 69	15	90
Neb. ♅ V. 47 Ursæ Majoris	9	55	+ 56	12	90
Neb. ♅ I. 79 Ursæ Majoris	10	8	+ 73	56	90
Neb. ♅ I. 283 Draconis	10	17	+ 75	12	40
Neb. ♅ I. 86 Leonis Minoris	10	21	+ 29	3	90
Neb. ♅ I. 87, 88 Leonis Minoris	10	56	+ 29	0	90
Neb. ♅ V. 46 and M. 97 Ursæ Majoris	11	7	+ 55	56	4h
Neb. ♅ I. 29 Leonis	11	9	+ 13	23	78
Neb. ♅ I. 121 Virginis	11	55	− 0	30	90
Neb. ♅ I. 33 Virginis	12	2	+ 10	58	70
Cl. M. 13 Herculis	16	38	+ 36	39	30 and 60m
Cl. M. 9 Ophiuchi	17	13	− 18	24	30 and 60m
Neb. ♅ VI. 41 Draconis	17	33	+ 75	48	60
Cl. M. 24 Clypei	18	12	− 18	28	60 and 2h
Cl. ♅ VIII. 72 Serpentis	18	22	+ 6	30	40

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	R.A. h m	Decl. ° ′	Expos. m
Neb. M. 57 Lyræ	18 49	+32 54	2h
Cl. ♅ VII. 19 Aquilæ	19 2	+ 4 4	60
Neb. in Aquila	19 6	+ 0 52	90
Cl. *h* 2035 Aquilæ	19 11	− 1 6	64
Cl. ♅ VIII. 21 Anseris	19 23	+24 56	50
Cl. ♅ VI. 38 Aquilæ	19 26	+ 9 0	60
Cl. *h* 2046 Vulpeculæ	19 36	+26 34	60
Cl. *h* 2048 Cygni	19 37	+39 56	60
Stars in Cygnus	19 45	+35 30	60
Cl. *h* 2053 Draconis	19 46	+59 10	60
Cl. ♅ VII. 9 Vulpeculæ	19 46	+22 50	60
Cl. ♅ VII. 59 Cygni	19 59	+43 37	60
Cl. ♅ VIII. 56 Cygni	20 19	+40 27	60
Cl. ♅ VII. 8 Cygni	20 30	+27 58	60
Neb. ♅ V. 15 Cygni	20 41	+30 20	67
Cl. ♅ VIII. 76 Cygni	20 51	+46 53	60 and 2h
Neb. ♅ V. 14 Cygni	20 50	+30 50	1h 37m
Neb. ♅ I. 52 Equulei	20 56	+15 47	40 and 90m
Region about ξ Cygni	21 1	+43 31	63 and 90m
Cl. *h* 2107 Cygni	21 7	+45 15	60
Cl. ♅ VI. 32 Cygni	21 27	+51 7	60
Cl. ♅ VII. 52 Cygni	21 28	+46 38	90
Cl. M. 39 Cygni	21 28	+47 58	60
Neb. in Cepheus	21 35	+56 59	2h 48m
Nova Cygni	21 37	+42 18	2h
Cl. ♅ VII. 66 and Neb. ♅ IV. 75 Cephei	21 42	+65 27	2h 5m and 3h
Cl. *h* 2141 Cephei	21 55	+54 19	60
Neb. ♅ II. 240 Pegasi	23 58	+15 33	2h 49m

Seven photographs of the eclipse of the Moon on March 10 were taken, and during totality the full disc, with some details, are shown on the plates, and upon two of them the trails of τ (and *comes*) *Orionis*, both at disappearance and at reappearance, are visible. Trails of other stars down to $9\frac{1}{2}$ magnitude are also shown.

Considerable time has been occupied in the investigation of the relative efficiency of the 20-inch reflector and of portrait lenses in the delineation of celestial objects, and a report upon the results obtained is prepared and may be submitted to the Society.

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The Earl of Rosse's Observatory, Birr Castle.

During the past year the determinations of lunar heat have been resumed, as opportunity afforded, with somewhat improved apparatus. No opportunity, however, has occurred for observing during a lunar eclipse.

Some experiments in astronomical photography have been proceeding. Great difficulty has been experienced in these from obscuring of the apparatus during prolonged exposures, but these hindrances have at last been overcome. In our uncertain climate, however, the opportunities for long exposures are not many. There has probably been at least an average of clear sky during the year, but an unusually large proportion of this occurred during the summer months, when no observing was going on.

The meteorological observations have been continued as usual.

Mr. Wilson's Observatory, Daramona, Streete, Westmeath.

During the past year a number of experiments have been carried out, and are still in progress, to find out the best method of detecting when a slight shift takes place in the 24-inch mirror on its supports when the telescope is used for long-exposure photography. This defect, to which all reflectors are more or less liable, is the most serious drawback against their use for stellar photography as compared to refractors.

During the spring the 24-inch was used by Professor Minchin with his photo-electric cells to determine the electromotive force of the light of some of the stars. The results have been published in the *Proceedings of the Royal Society*, vol. lviii. The experiments on the radiation of heat from Sun-spots have been carried on by means of the large heliostat. The spots have greatly diminished both in size and number during the year. A 4-inch photo-heliograph has been mounted, and a solar photograph is taken at the time that the solar radiation is being measured, in order that a permanent record may be kept of the positions and sizes of the spots. Some fine negatives have been obtained by its use.

The weather has been very cloudy, particularly during the latter part of the year.

Hongkong Observatory.

Hourly observations and continuous meteorological records, weather forecasts, storm warnings, investigations of typhoons, magnetic observations, and the public time service have been continued as usual. Eleven annual volumes have now been pub-

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lished, and the twelfth volume is progressing. Observations of shooting stars have been made by the Director, and sixty-three radiants, many of them southern ones, have been determined. With the Lee Equatorial, double stars have been observed by the Director, the angles with the old wire micrometer, and the distances with the spherical crystal; but this instrument has seen its best days, and there is no dome over it, so that it has to be dismounted in bad weather. It is intended to bring the orbits of double stars calculated at Markree up to date, and correct the elements by the method of least squares. A commencement has been made with *α Centauri* and *γ Virginis*, and the observations of all the stars in question contained in books in my possession have been tabulated. Double-star observers are invited to forward their observations either in printed form or in manuscript.

Madras Observatory.

As for several years past, the work of the Observatory has been confined as far as possible to the reduction and publication of the old observations.

Considerable progress has been made with the General Star Catalogue, and the mean places for 1875·0 have been deduced for the first four hours.

The investigation of the circle errors, begun last year, has not yet been completed, as it was found necessary to send the microscopes home to have the screws, which were much worn, replaced by new ones. This has now been done, and the work is again in progress.

During the year the Government Astronomer drew up detailed plans, in consultation with astronomers at home, for the new Kodaikanal Observatory, and in October the foundation-stone of the Observatory was laid by H.E. Lord Wenlock, but the buildings have not made much progress.

The Government of India having accepted, as a trust, the G. V. Jugga Row Observatory, at Vizagapatam, a committee has been appointed to administer the trust, and the Government Astronomer has the supervision of the astronomical work. The principal instruments at the Observatory are an excellent 6-inch equatorial and a small photographic telescope. No regular observations have yet been begun, but it is intended, as soon as the instruments have been put in good order, to undertake comet work as a special subject.

Natal Observatory.

The work of the Natal Observatory during the past year has been mainly routine work, the Astronomer having been absent on leave in Europe for the greater part of the year.

The new Tables of the Moon, forming a supplement to Hansen's Tables, are being computed, the data on which they are compiled serving to bring the tables into harmony with observations during the entire period 1680–1894, the errors of short period being almost completely eliminated.

Sydney Observatory.

During 1895 the usual work has been carried on with the meridian circle. The weather has, however, been exceptionally bad. Bush-fires have been very prevalent during August, September, and October, owing to the drought and strong winds; hence the smoke has been so thick that the horizon was often not more than a mile distant. Cloud also has been very abundant, and only 96 nights have been clear.

Meridian Circle.—With the meridian circle 1,488 transits have been taken, 408 of these being transits of the Sun, and the remainder of stars. Eight hundred and fifty-three north polar distances have been observed. Fifty-three of these were stars specially selected by Sir Charles Todd with a view of making a new determination of Australian latitudes. In this work we have taken a part with Melbourne and Adelaide. The remaining stars are reference stars for our photographic zone.

Azimuth of the meridian circle has been determined 85 times.

Collimation	299
Level	373
Nadir	363

A series of observations to determine the flexure of the meridian circle has been commenced. Fifty-four determinations have been made, and so far confirm the old value. The computations of 1895 observations are well advanced. The Government printer has not found time to publish another volume of the meridian work, which is waiting for him.

Equatorial.—Owing to cloud, smoke—already referred to—and visitors, only 64 evenings were available for the measurement of double stars. Fifty-eight have been measured. In doing this 751 settings for position-angle and 831 for distance have been made. Five stars supposed to be double have been carefully examined several times without detecting companions. The occultation of *Antares* by the Moon was observed in both phases and the results published.

Star Camera.—At the end of 1894 only 70 plates required to be taken in order to complete those for catalogue stars in our zone. Of these 59 have been taken; the other 11 were passed by accidents of cloud and weather. The total number of photographs of stars taken during the year is 502. Of these 381 are

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chart plates, 59 catalogue plates, and 58 for various purposes —the investigation of star clusters and the retaking of a number of catalogue plates which were taken two or three years since, the object being to see if the same number of stars would be found on both sets of plates. Reference has already been made to the weather as the cause of the short amount of work; it has, however, told more on the star camera than on the other instruments, because there were many hazy nights, when the stars could be seen, but not photographed, the reason being that in long exposures the haze reflects enough of the city light to fog the plates. Half an hour is the exposure given to chart plates in good weather, but this has been extended in hazy weather or unsteady definition. A few special observations were made to determine the actual amount of motion in the star images on nights of bad definition. Some nights were so bad that a double star distance 6″ could not be divided with the large equatorial; the two looked like one spot of light. On a good night this telescope will readily divide a pair at distance 0″·5. Photographic star discs are enlarged by this motion in the atmosphere; frequently they were three times as large in diameter as they ought to be. The light was therefore distributed over nine times the surface, and took nine times as long to photograph; so that a star of the 11th magnitude, which on a good night is photographed in one minute, would take nine minutes; and practically it is found that satisfactory photographs of stars cannot be obtained upon nights of such bad definition. It being impossible to take chart plates whenever the Moon is at all bright, the photographer has been engaged in making lantern slides of star groups, with great success. They are the finest I have seen.

Zone Time.—Zone time was adopted in this colony on 1895 February 1—that is, the time of the meridian 150° of longitude east of Greenwich.

Meteorology.—The meteorological work has been carried on as usual—a large increase in the number of observers, and a corresponding expansion of the work.

General.—During the year 4,600 copies of various publications have been distributed. These are chiefly meteorological, but include the chart of circumpolar stars, &c.

Visitors.—The number of visitors to the Observatory persistently increases, and is becoming a very serious tax upon the staff. The majority come to see the Observatory in the daytime; the others come at night, and are a still more serious difficulty, for the telescope had to be given up to them on thirty-one nights. The total number is 1,050. In addition to these, 459 persons came to see me personally on business connected with the Observatory, and 123 letters asking for information have been received, to answer which occupied the time of one clerk 187 hours. However much this tax on the time of the Observatory staff is to be deplored, it is at present impossible to avoid it.

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Mr. Tebbutt's Observatory, The Peninsula, Windsor, New South Wales.

Although much cloudy weather was experienced at both the beginning and the end of the year 1895, a fair amount of work was accomplished. The local sidereal time was determined on 184 nights, and for this purpose 957 transits of stars with a declination not exceeding 40° were observed. The determinations of the level, collimation and azimuth errors of the transit instrument were 454, 52, and 159 respectively. The level and azimuth errors have undergone great progressive changes during the year. Relatively the eastern pivot fell slowly from the beginning of the year till towards the close of February. From that time it gradually rose till about March 23; but subsequently it fell till the end of the year, and it was found necessary to raise it by adjustment no fewer than fourteen times during that period. The north end of the axis of collimation moved persistently westward throughout the year, and at the close the azimuth *west* had attained to nearly a minute of arc. When the steadiness of the instrument for some years past is taken into consideration these changes are remarkable. The behaviour of the standard sidereal chronometer has been satisfactory, the mean daily gaining rate being 3·05 seconds.

In the extra-meridian department the following work has been done. Sixty-four phases of lunar occultations of stars have been observed, comprising thirty-five disappearances at the dark and ten at the bright limb, and fourteen reappearances at the dark and five at the bright limb. Twelve *Nautical Almanac* stars, of which *Antares* on May 10 was one, were observed in both phases. B.A.C. 6127, a star of the 5th magnitude, was well observed with the 8-inch telescope in both phases, and in full sunlight, on August 29. The details of this interesting observation are given in the *Observatory* for 1895 November. During the past thirty-two years 691 occultation phases have been observed, and the year 1895 presents the greatest number secured in any one year during that period. The thanks of myself, and astronomers generally, are due to Mr. Joseph Brooks, F.R.A.S., the officer in charge of the local trigonometrical survey, for his kindness in providing the Observatory with prediction calculations of occultations for the year. The series of observed occultations for 1873–76 was used some years ago by Dr. Auwers for the determination of a fundamental meridian for Australia. The series for 1864–70 is now in the hands of another astronomer for a similar purpose, and it is hoped that the much longer series for 1877–95, which has been obtained with better instrumental means, will leave little to be desired in the way of data for the determination of Australian longitude.

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Filar micrometer comparisons of *Jupiter* and 1 *Geminorum* were made on the 8-inch equatorial on January 5 and 10. Similar comparisons were made of *Saturn* with κ *Virginis* on May 6, 7, 9, 13, 15, 16, and with 96 *Virginis* on August 4, 8, 9, 10, 11, 12. The minor planets *Ceres* and *Hebe* were also compared micrometrically with neighbouring stars on fourteen and eleven nights respectively, the former in pretty high south declination, and the latter at the request of Dr. Luther, of Düsseldorf.

In consequence partly of the want of ephemerides, but mainly of the cloudy state of the skies in December, nothing was seen of the comets discovered by Perrine and Brooks. A brilliant comet was reported to be visible in the south-west at several places in Victoria and South Australia, but no chance was afforded here for getting a view of the stranger. It probably passed quickly into the northern hemisphere.

Observations of the phenomena of *Jupiter's* satellites were made in February, March, April and May. The earliest visible eclipse of the fourth satellite for the current cycle was partly observed on April 11, the reappearance occurring $13^m\ 17^s$ before the time given in the *Nautical Almanac*.

Measures of seventeen well-known southern double stars have been made, comprising forty-five nights, 815 settings for position-angle, and 348 for distance. The results for α and γ *Centauri* and γ *Coronæ Australis* have been sent to Dr. See, of Chicago, and those of α *Centauri* to Dr. Doberck, of Hongkong, in accordance with applications from those astronomers.

η *Argûs* was examined on a few occasions and a well-connected series of comparisons of *R Carinæ* was obtained, from which it appears that the maximum of this variable was attained on May 13, =5·1 of the magnitude scale of the *Uranometria Argentina*. This was brighter than the maximum of 1894 by half a magnitude, and is the eleventh satisfactorily determined at Windsor since 1879. A comparison of the Cordoba observations in 1871 with those at Windsor in 1895 gives a mean period of about 311 days from maximum to maximum. This is a day less than that deduced from the comparisons down to 1886.

The meteorological observations have been regularly made during the year, and the last winter proved to be the coldest experienced at the Observatory for thirty-three years. The abstracts for 1891–92–93–94–95 are now nearly ready for the printer.

Finally, all the astronomical observations and their reductions have been made by the proprietor, and nearly all the meteorological observations, with their reductions, have also been made by him.

Lovedale, South Africa. (Mr. A. W. Roberts's.)

The work here has been the observation of variable stars south of -30° Decl. The systematic search for short-period variables carried on in previous years was given up in 1895, as the number of known variables had so increased that only the regular observation of such stars could be undertaken.

Two new variables, however, were discovered, one in *Crux* and the other in *Vela.* The stars *X Carinæ* and *R.S. Sagittarii* were proved to be of the Algol type. The former star was discovered at Lovedale and the latter at Cordoba, by Dr. Gould.

Observations were made on 114 nights, the particulars being as follows :—

Algol variables (4 stars)	901
Short-period variables (17 stars)	1296
Regular long-period variables (16 stars)	594
Suspected variables (15 stars)	102
	2893

Each of the above observations is the mean of two, one direct and the other reverse. This mode of observation has been adopted to eliminate "position error."

As each observation also means, on the average, the determination of five comparison stars, the individual determinations of magnitude throughout the year are considerably over 30,000.

The position of the Observatory is—

$$\text{Long. } 1^{\text{h}}\ 47^{\text{m}}\ 24^{\text{s}}{\cdot}5 \text{ E.}$$

$$\text{Lat.} -32^{\circ}\ 46'\ 30''$$